NBSA Remedial Alternative Screening (RAS) Process: Sediment Management Area Development

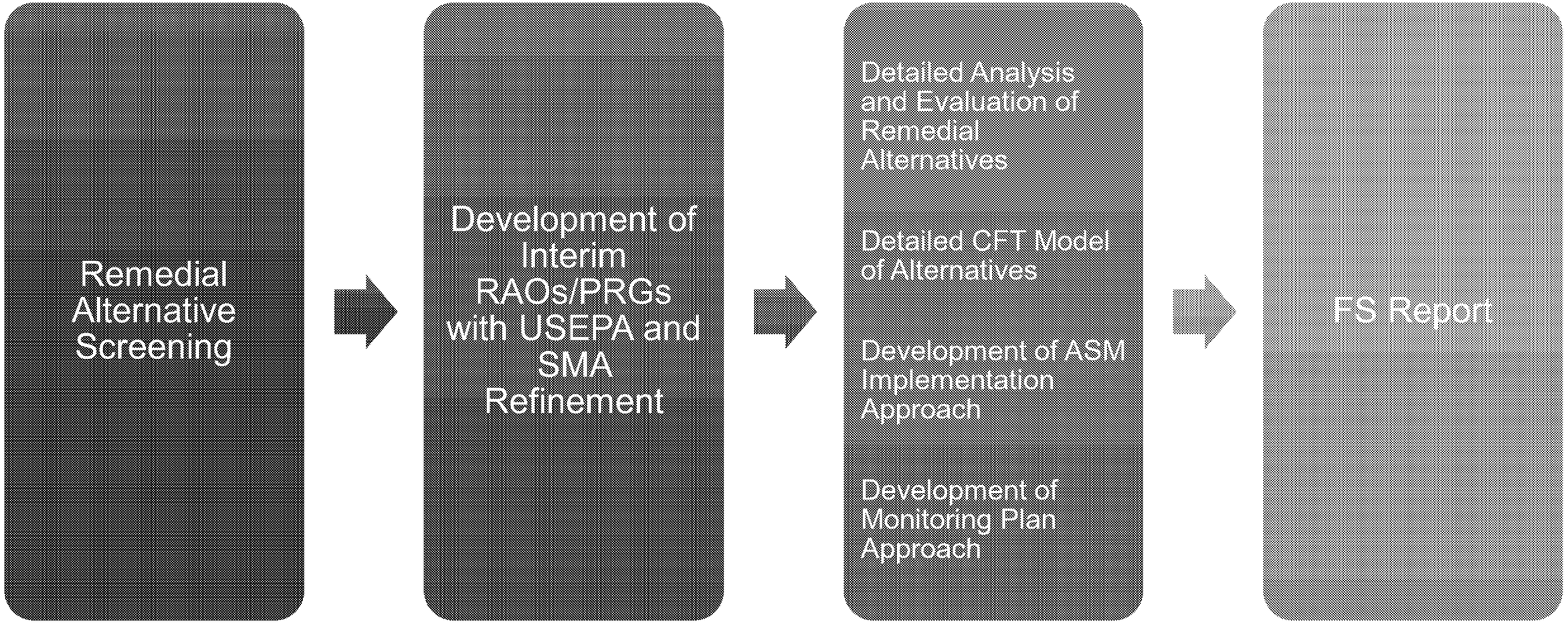
September 21, 2022

OXY GLENN SPRINGS HOLDINGS, INC.

Agenda and Meeting Goals

- NBSA and Adaptive Site Management (ASM)
- Review Proposed Feasibility Study (FS) Subarea Boundaries
- Identify Preliminary Areas of Interest (AOIs)
- Review Proposed Hilltopping Evaluation and Sediment Management Area (SMA) Delineation Process
- Discuss SMA Development and Integration with ASM Approach
- Discuss Appropriate “Book End” for the Upper Range of Preliminary Alternatives
- Develop Next Steps and Goals for USEPA Workshop Advancing RAS Process

NBSA and Adaptive Site Management

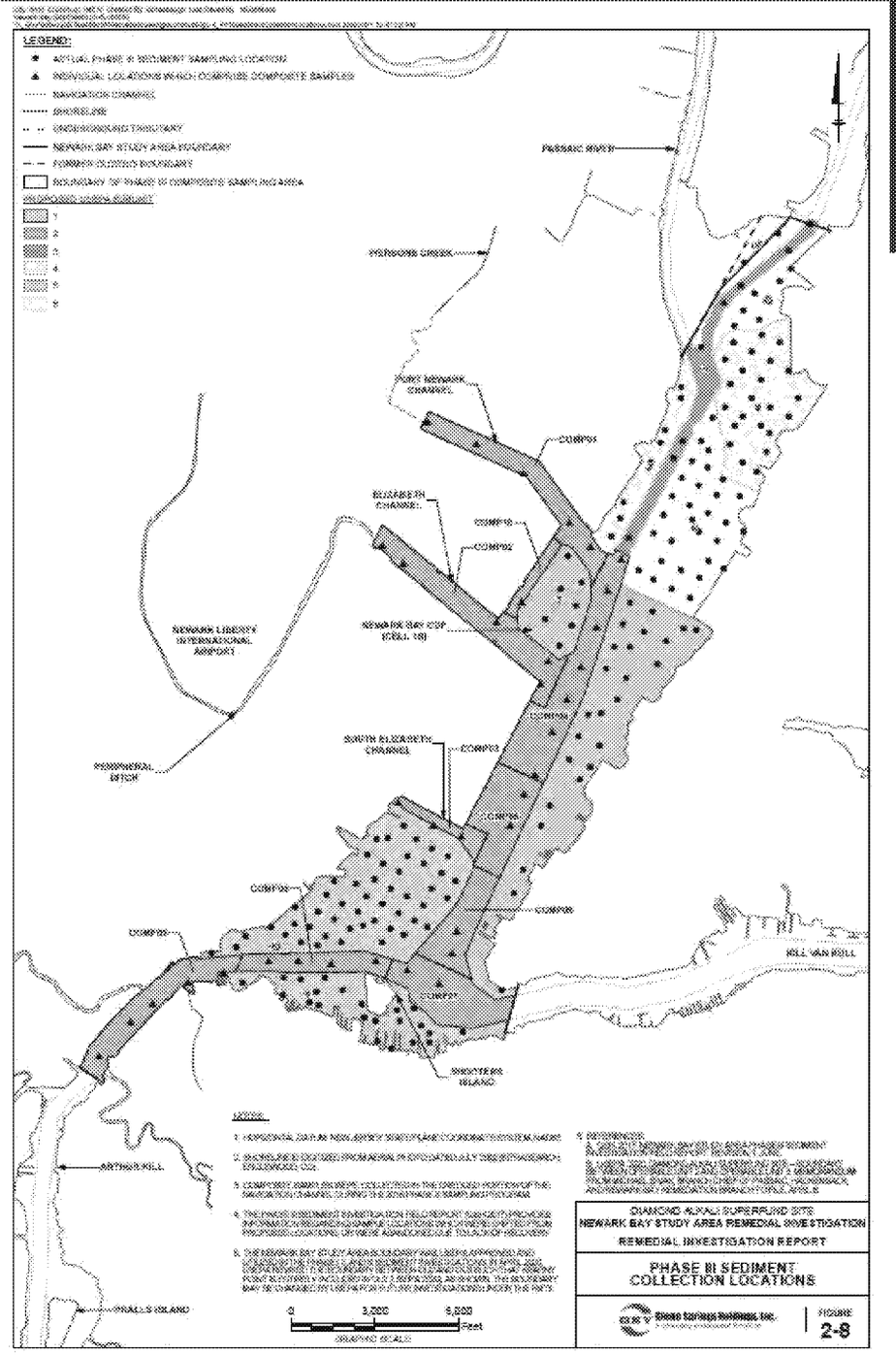


Acronyms:
ASM: adaptive site management
CFT: contaminant fate and transport model
FS: feasibility study
PRG: preliminary remedial goal
RAO: remedial action objective
SMA: sediment management area

PROPOSED FS SUBAREA BOUNDARIES

Terminology

- **FS Subareas**
  - Refinements to the USEPA Phase III subunit boundaries (as presented in the Remedial Investigation [RI])
    - USEPA Phase III subunits were identified as a result of "consideration of modeled bottom shear stresses, bathymetry, geomorphological features, and navigational/anthropogenic activity"
  - Information relevant to alternative development and selection is incorporated to establish a "base map" for the FS
  - The identified areas may support FS decision-making and long-term monitoring program design



FS Subarea Map

Legend

- Newark Bay Study Area Boundary
- Current Navigation/Port Channel (No Action)
- Shoreline
- State Boundary
- CDF Boundary (No Action)
- Current Navigation/Port Channel Transitional Slopes (No Action)
- USACE Harbor Deepening and Channel Improvements (including 3:1 transitional slope)
- Remedial Action Area by Others

Draft FS Subareas

- Northwest Subtidal Flats and Industrial Waterfront Areas
- West Transitional Slope of Droyers Reach
- Northeast Subtidal Flats and Industrial Waterfront Areas
- Eastern Central Subtidal Flats and Industrial Waterfront Areas
- Shooters Island
- Southwest Subtidal Flat and Industrial Waterfront Areas
- Staten Island Waterfront
- Western Central Subtidal Flat
- Intertidal Areas

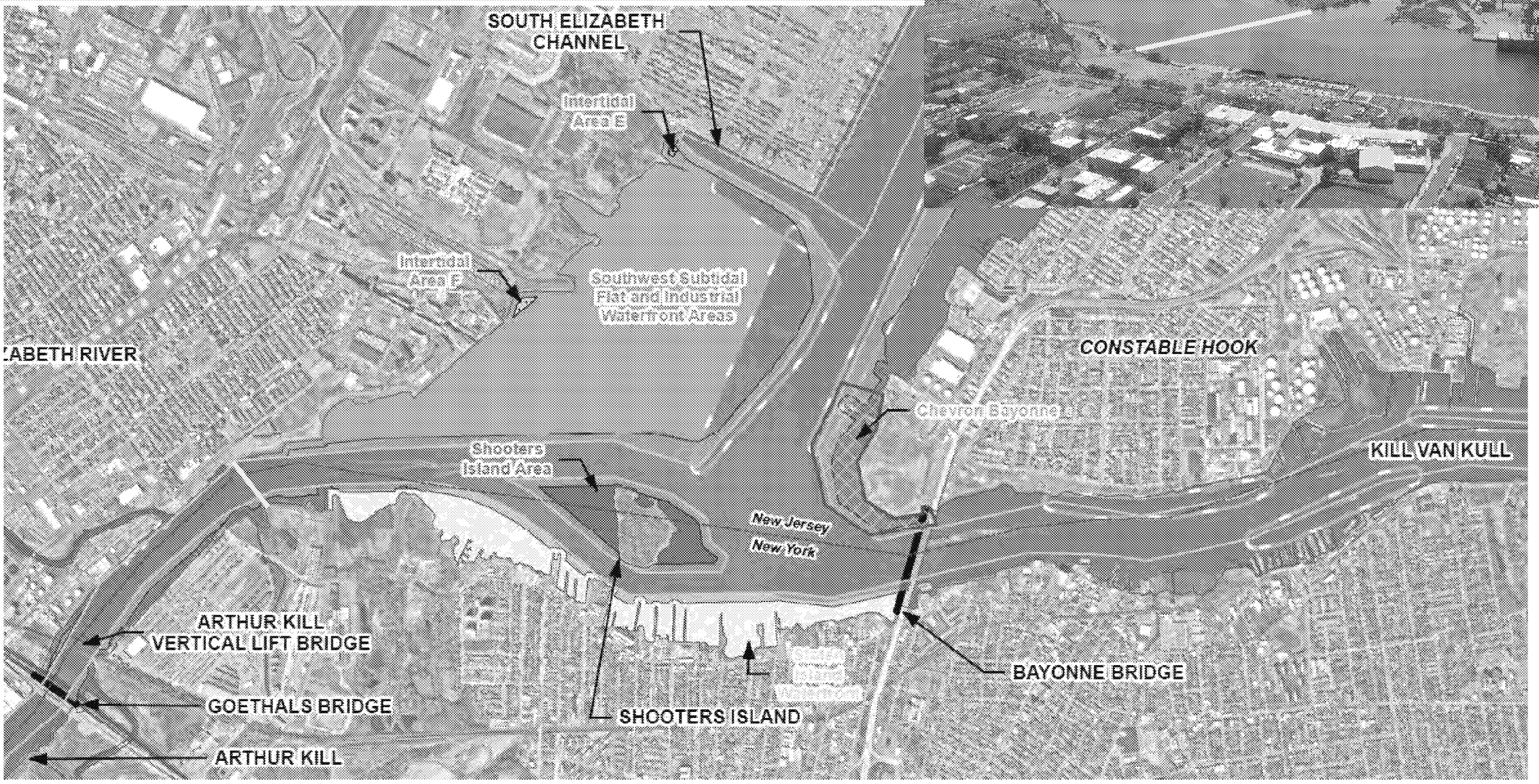
Notes:

1. Footprint of Honeywell Study Area 7 Sediment Remedy is approximated from the SA7 Sediment Remedy Area included in the *Study Area 7 Sediment Remedy, Documentation and Remedial Action Summary Report* (Honeywell 2014).
2. Footprint of Chevron Bayonne is approximated from remedial investigation footprint included in the *Supplemental Remedial Investigation Report for the Former Texaco Refining and Marketing Inc. and Former Pirelli Cable Company Site (Chevron Bayonne)* (Parsons 2016).

FS Subarea Boundaries

- Refinements for purposes of FS:
  - Designate Navigational/Port Channels & Transitional Slopes as No Action Areas
    - Existing channels
    - USACE Harbor Deepening and Channel Improvements footprint including planned 3:1 transitional slope
  - Designate Newark Bay confined disposal facility (CDF) (Cell 1S) as No Action Area
  - Define intertidal areas as FS subareas separate from subtidal areas
  - Apply administrative boundary at OU2/OU4
  - Identify state-led remediation projects completed and/or underway
  - Propose Arthur Kill boundary shift from Goethals Bridge to Bay entrance

Proposed Subarea Boundaries Near Arthur Kill



PROPOSED HILLTOPPING EVALUATION AND SEDIMENT MANAGEMENT AREA DELINEATION PROCESS

Terminology

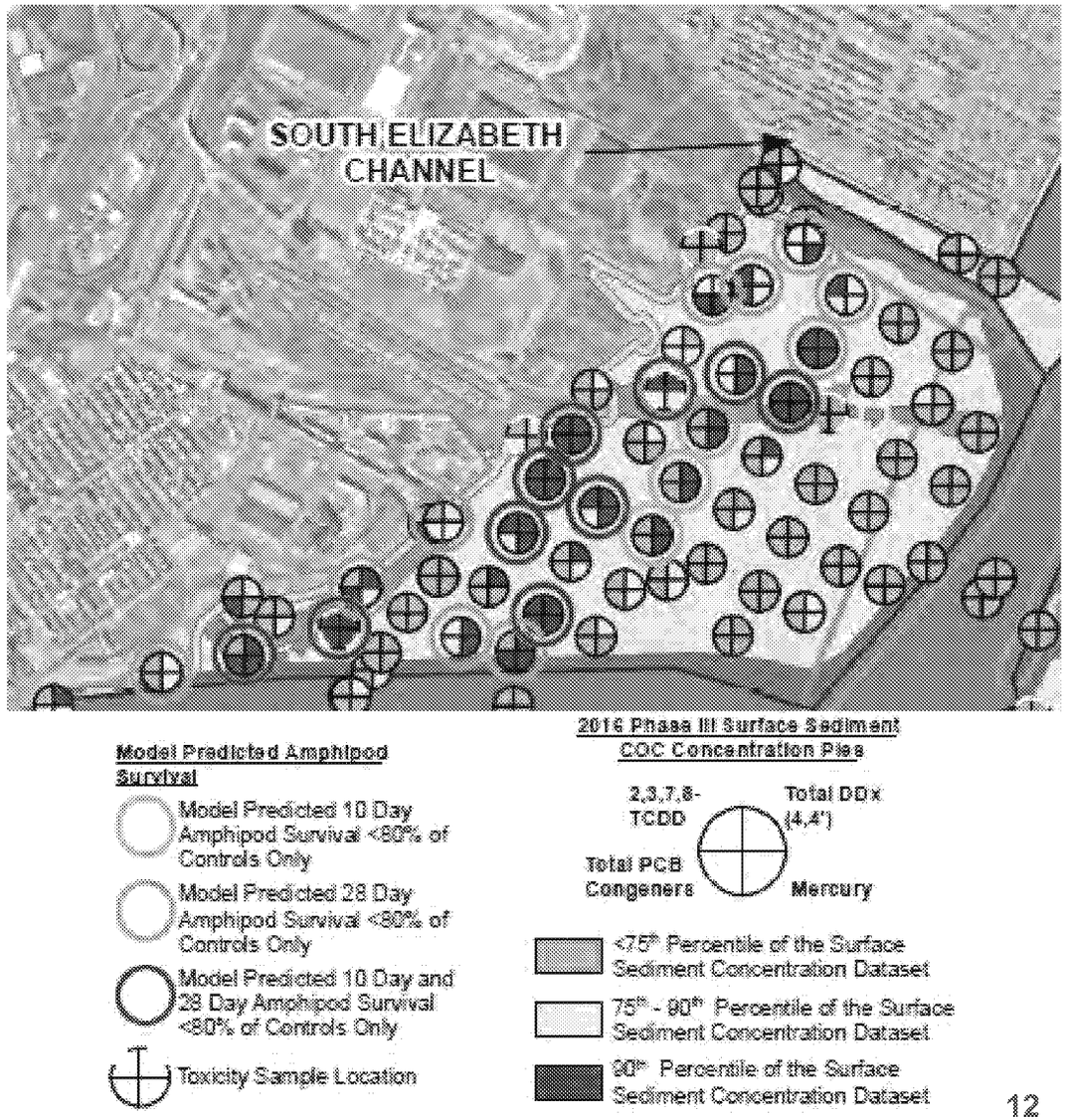
- **Areas of Interest (AOIs)**
  - Notable areas of locally elevated surface sediment constituent of concern (COC) concentrations and/or toxicity compared to other areas of the bay, and generally persist in the contaminant fate and transport (CFT) model baseline forecast
  - Potential priority areas for remediation
- **Sediment Management Areas (SMAs)**
  - Areas with common physical and chemical characteristics considered for potential active remediation (i.e., interim action)
  - Multiple SMAs can be adjoining or separated by areas not considered for active remediation

Identify Areas of Interest

Criterion used to Define AOIs	Data Sources
Surface Sediment COC Concentrations	• Phase III COC Concentrations
Risk	• Baseline ecological risk assessment (BERA) and human health risk assessment (HHRA) • Actual and modeled toxicity testing (10-day and 28-day amphipod survival)
Stability/Natural Recovery	• Physical stability of sediments • Phase III COC concentration profiles • Geochronology • Hydraulic conditions and physical features of OU3 (e.g., proximity to navigational channels or marinas) • CFT model

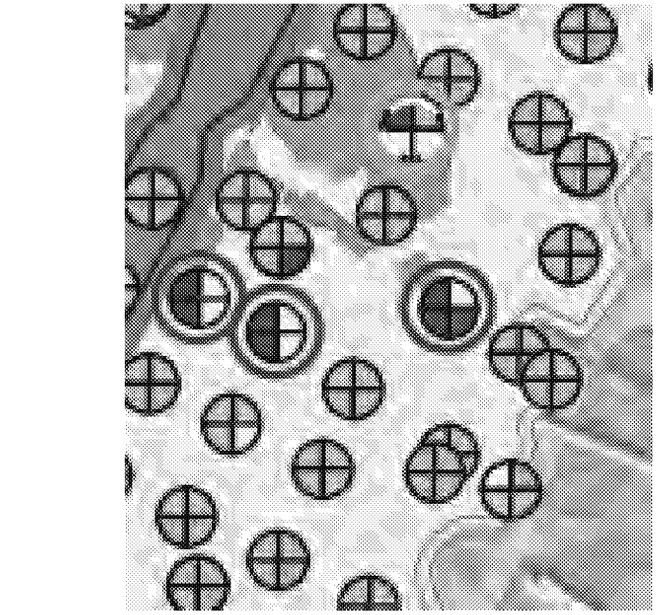
Southwest Subtidal Flat Area of Interest

Criterion Used to Define AOIs	Evaluation Results
Surface Sediment COC Concentrations	• Clusters of COCs within 75th to 90th percentile of measured concentrations • Colocation of elevated COC concentrations
Risk	• Acute toxicity for amphipods predicted in 23% of samples collected from southwest subtidal flat (13 of 57 samples) • Chronic toxicity for amphipods predicted in 33% of samples collected from southwest subtidal flat (19 of 57 samples) • Colocation of acute and chronic toxicity predictions
Stability/Natural Recovery	• Decreases between Phase I/II and Phase III surface sediment COC concentrations • CFT model forecasts slower recovery of Total DDx (4,4') and mercury concentrations in surface sediment in this area



Northern Subtidal Flat Area of Interest (Near I-78 Bridge)

Criterion used to Define AOIs	Evaluation Results
Surface Sediment COC Concentrations	• Clusters of COCs within 75th to 90th percentile of measured concentrations • Colocation of elevated COC concentrations
Risk	• Acute toxicity for amphipods predicted in 3 samples collected proximate to I-78 bridge • Chronic toxicity for amphipods predicted in 4 samples collected proximate to I-78 bridge • Colocation of acute and chronic toxicity predictions
Stability/Natural Recovery	• No-net-change or increases between Phase I/II and Phase III surface sediment COC concentrations • CFT model forecasts slower recovery of 2,3,7,8-TCDD, Total DDx (4,4'), Total PCBs, and mercury concentrations in surface sediment in this area



SMA Identification Process

Prepare Surface Sediment COC Interpolation Maps Using Inverse Distance Weighted (IDW) Method

Evaluate Range of Candidate RALs vs Associated SWAC Reduction Targets via Hilltopping

Select Proposed RALs and Identify Potential Remediation Areas

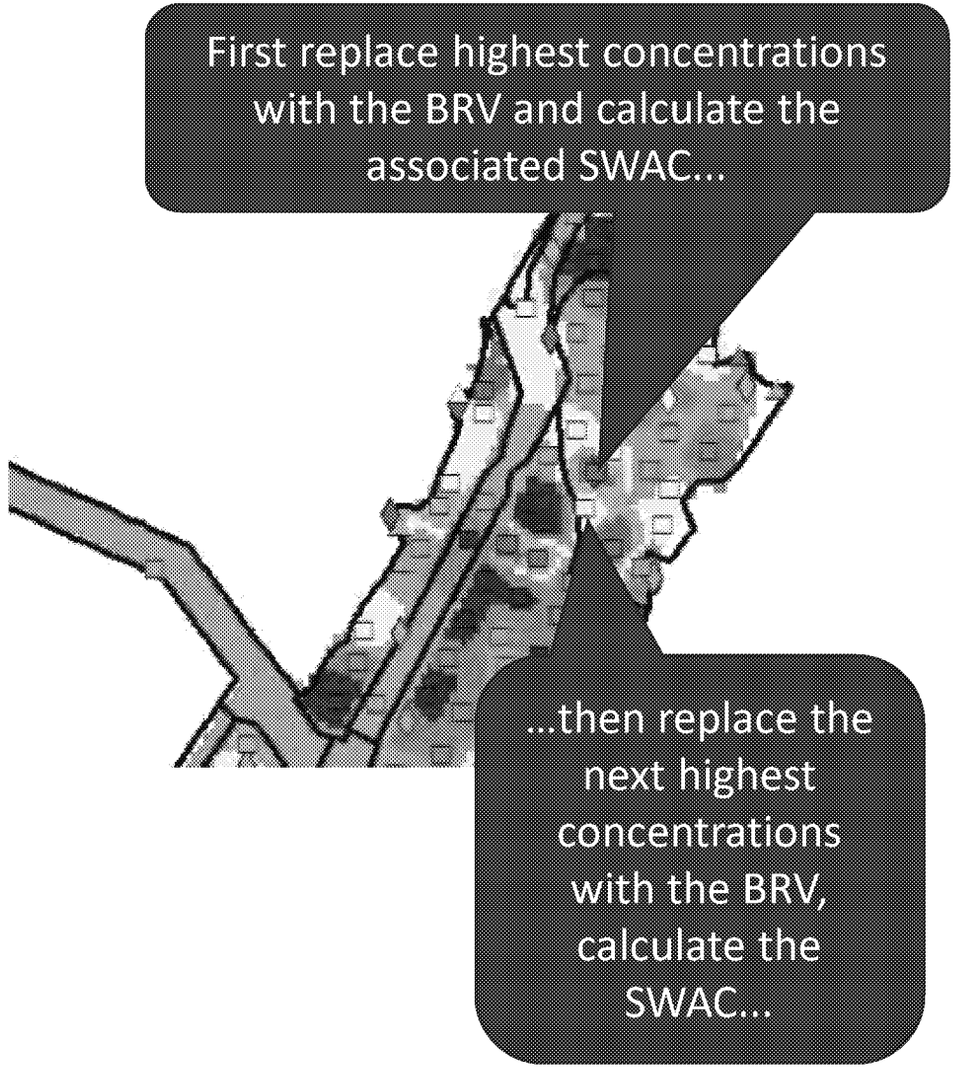
Define Boundaries of Proposed SMAs

Terminology

- **Bed Replacement Value (BRV)**
  - Site-specific concentration of a COC used to replace concentrations within an area ("cell") during hilltopping to simulate effect of remediation
- **Remedial Action Levels (RALs)**
  - The maximum concentration that may be left in place, such that the post-remedial action SWAC is below the target SWAC (e.g., preliminary remedial goal [PRG], interim goal, or other accepted endpoint)
  - Candidate RALs are values among a range of values in consideration for use in defining SMAs
- **Knee-of-the-Curve**
  - Point on the candidate RAL vs. SWAC curve where further increasing potential area of remediation (i.e., reducing RAL) yields diminished progress toward achieving RGs

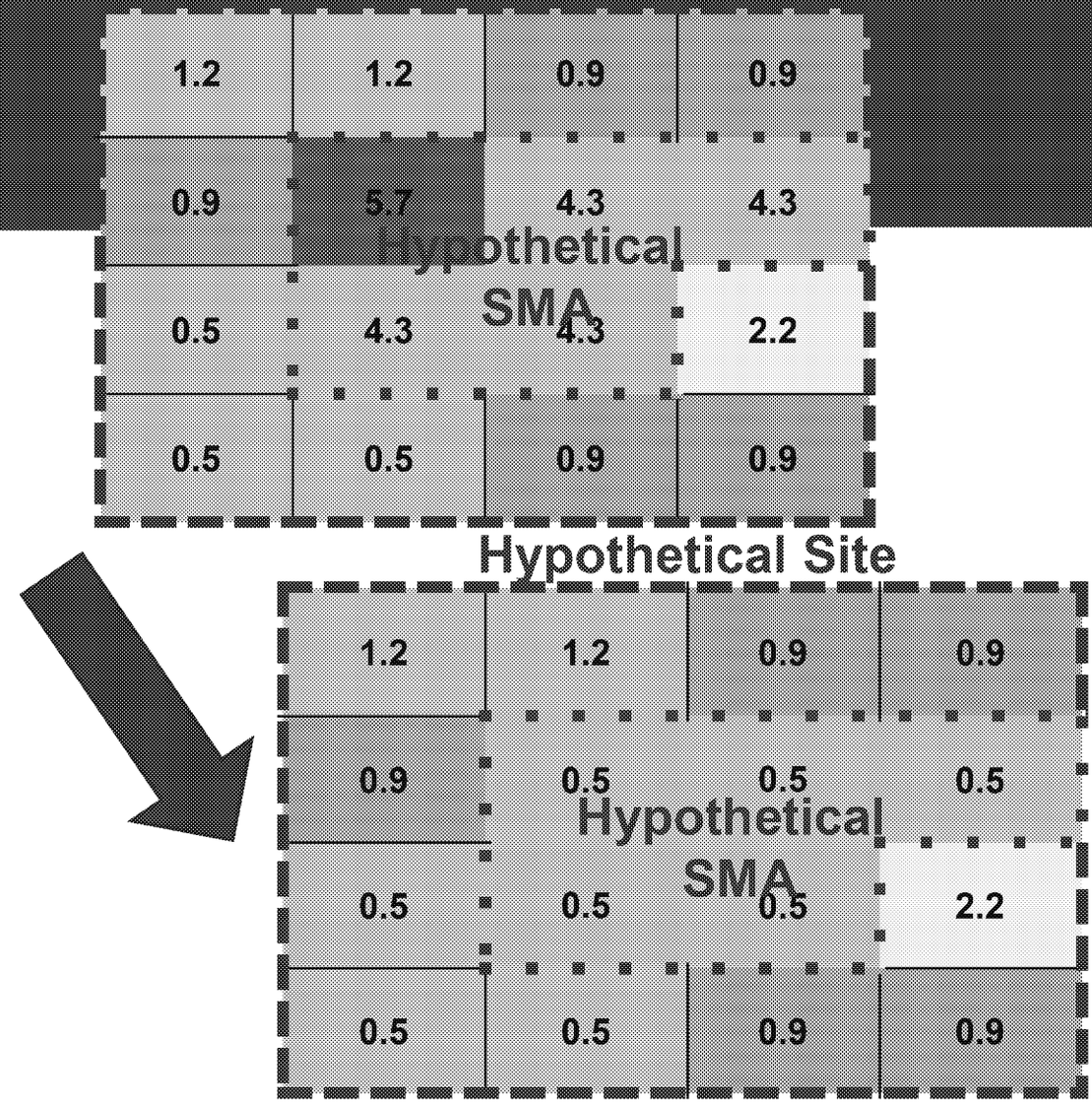
Hilltopping Procedure

1. Interpolate data to create a continuous grid with estimated concentrations for each COC
2. For a range of progressively lower simulated action levels:
   - Identify area greater than simulated action level
   - Iteratively replace each value > simulated action level with a BRV
   - Calculate the resulting SWAC (FS subarea and NBSA-wide)
   - Plot the area and SWAC vs. simulated action level
3. Examine the remedial area and SWAC plots against an array of candidate RALs to support SMA identification
4. Select proposed RAL and develop associated SMA boundary based on either SWAC attainment (current or future) and/or knee-of-the-curve



Hypothetical Hilltopping Example

Point	Max Concentration (µg/kg)	SWAC (µg/kg)	Cells Remediated
1	5.7	2.1	0
2	4.3	1.8	1
3	4.3	1.5	2
4	4.3	1.3	3
5	4.3	1	4
6	2.2	0.8	5
7	1.2	0.7	6
8	1.2	0.67	7
9	0.9	0.62	8
10	0.9	0.6	9
11	0.9	0.57	10
12	0.9	0.55	11
13	0.9	0.52	12
14	0.5	0.5	13
15	0.5	0.5	14
16	0.5	0.5	15
17	--	0.5	16



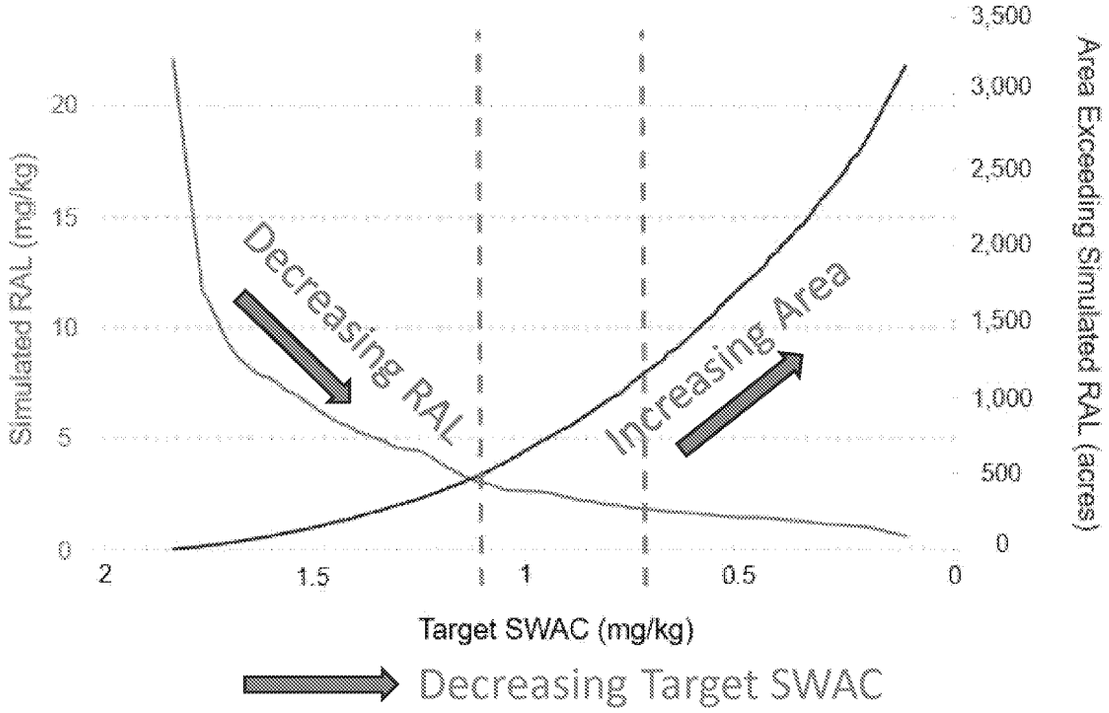
In the example:

- "Remediated" 5 cells using BRV = 0.5 µg/kg
- Resulting SWAC = 0.8 µg/kg
- Max concentration remaining (RAL) = 2.2 µg/kg

Hypothetical Hilltopping Example

- Results can be plotted to relate the resulting SWAC (x-axis) to both the associated RAL (left y-axis) and the corresponding area exceeding the RAL (second y-axis on right).
- Potential target SWAC values (the dotted green lines) can be evaluated to understand area of potential remediation.

Example Chart of Hilltopping Results



Range of Potential Bed Replacement Values

- BRVs simulate post-remedy bed sediment conditions.
- Potential BRVs range from water column particulate concentrations to borrow source acceptance criteria.

COC	Units	Water Column Solids Concentrations (Mean of NBSA Stations)[1]	Borrow Source Acceptance Criteria[2]
2,3,7,8-TCDD	ng/kg	81.3	4.15
Total PCB Congeners	µg/kg	554	25
Total DDx (4,4')	µg/kg	68.5	0.150
Mercury	mg/kg	1.29	0.037
Arsenic	mg/kg	18	8.2
Lead	mg/kg	109	65
Nickel	mg/kg	23.9	21
Total Alkylated PAHs	µg/kg	TBD	TBD

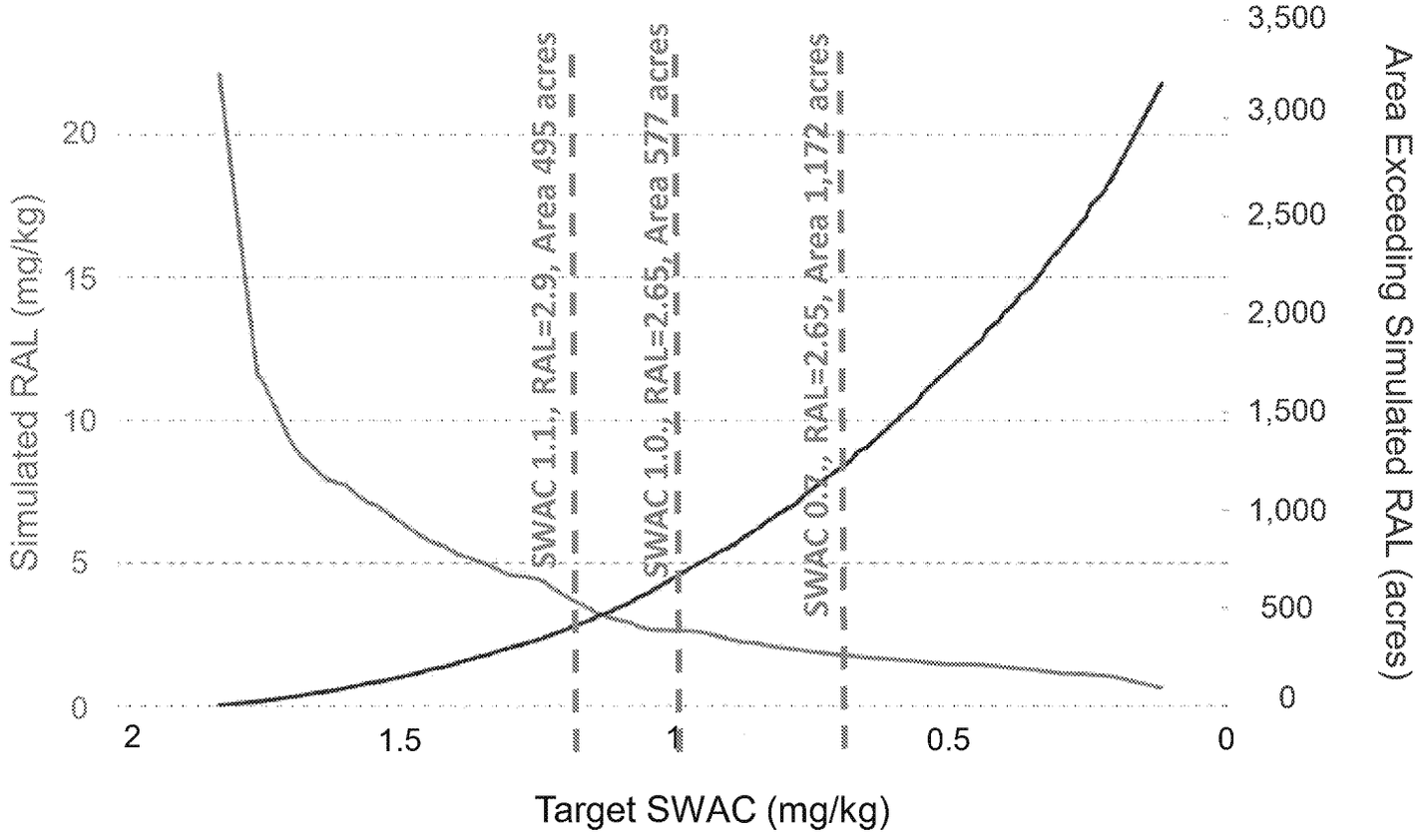
Sources:

1. Glenn Springs Holdings. 2022. *Remedial Investigation Report, Newark Bay Study Area, Newark, New Jersey*. Table 4-21. Prepared by Arcadis. May.
2. Glenn Springs Holdings. 2022. Appendix B of Construction QA/QC Plan. OU2 Remedial Design. June.

Potential Basis for RAL Selection

- PRG attainment after implementation, for example:
  - RAL that attains PRG upon implementation
  - RAL that attains potential interim value upon implementation
- RAL based on progress toward PRG attainment during CFT model forecast period, for example:
  - RAL calculated to attain PRG within 20 to 30 years after implementation
  - RAL that yields 70% of target value attainment upon implementation and relies on natural recovery to ultimately attain PRGs (no stated time-to-target)
- RAL based on the practical knee-of-the-curve approach, indicating point of diminishing return, with corresponding time-to-target estimate
- It is proposed RALs should minimize areas without sustainable remediation benefit due to contamination potential (i.e., apply water column particulate BRVs)

Example Hilltopping Results: Mercury Site-Wide



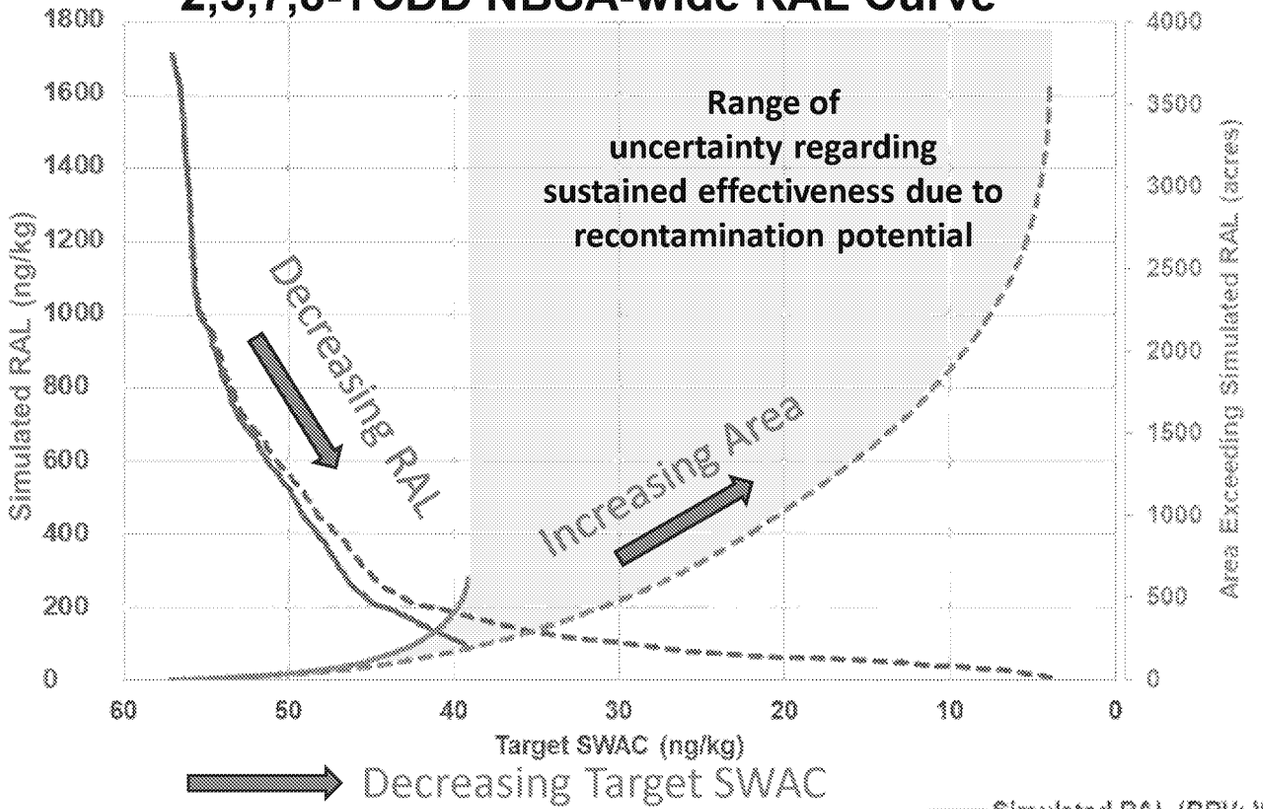
Potential Remedial Area Basis	Mercury RAL Curve (BRV= 0.037 mg/kg)		
	Candidate RAL (mg/kg)	SWAC (mg/kg)	Area (acres)
HH PRG: Noncancer Sediment PRG RME (American eel)	2.9	1.1	495
Knee-of-the-Curve	2.65	1	577
USEPA Proposed Draft OU3 RG	1.8	0.7	1,172

Time-to-Target Evaluations and RAL

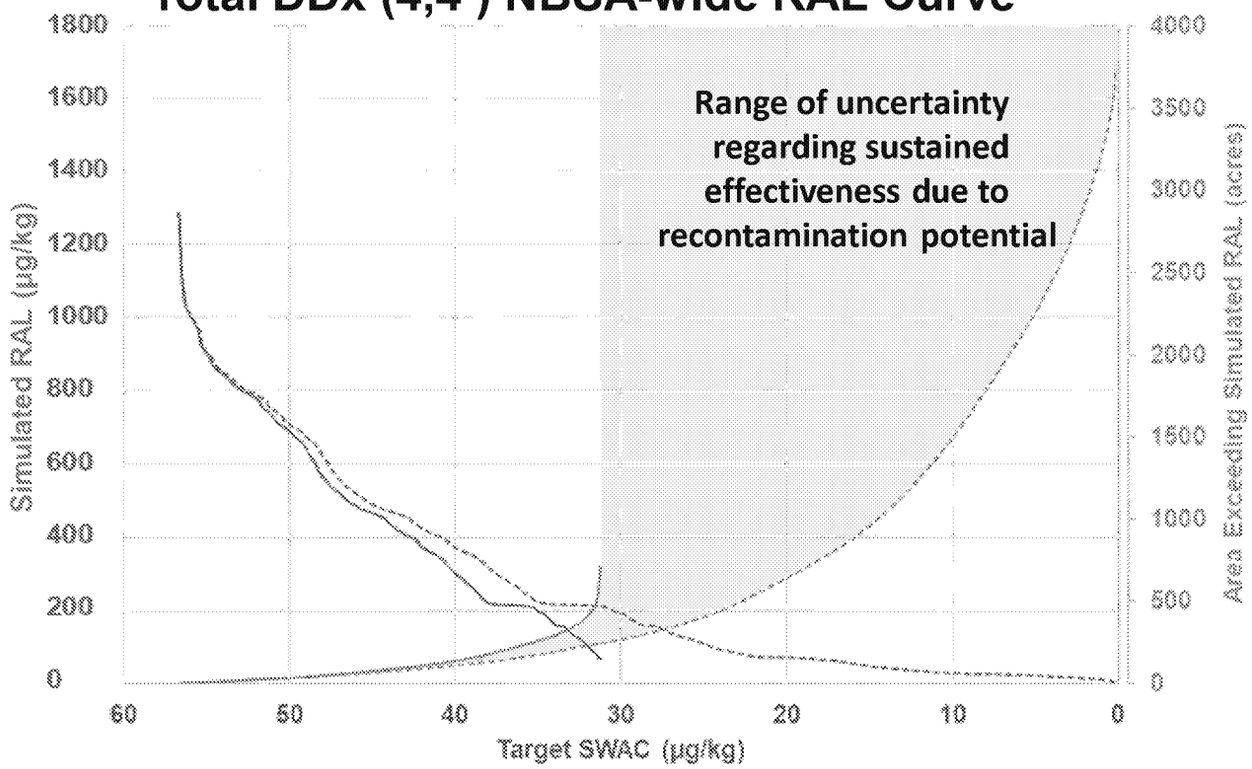
- Baseline forecasts allows estimate of SMA and time-to-target relationship:
  - Can estimate RAL and SMA needed to achieve specific time-to-target scenarios.
- Key uncertainties affecting SMA development based on time-to-target scenarios:
  - Continuation of sources that limit attainment of target concentrations
  - Continuation of sources that limit rate of recovery
  - Timelines for external source control actions
- Extent of SMAs potentially affected by source uncertainties can be estimated:
  - Examine difference between water column particulate and borrow source BRV results.

2,3,7,8-TCDD and Total DDx (4,4') RAL Curves

2,3,7,8-TCDD NBSA-wide RAL Curve



Total DDx (4,4') NBSA-wide RAL Curve

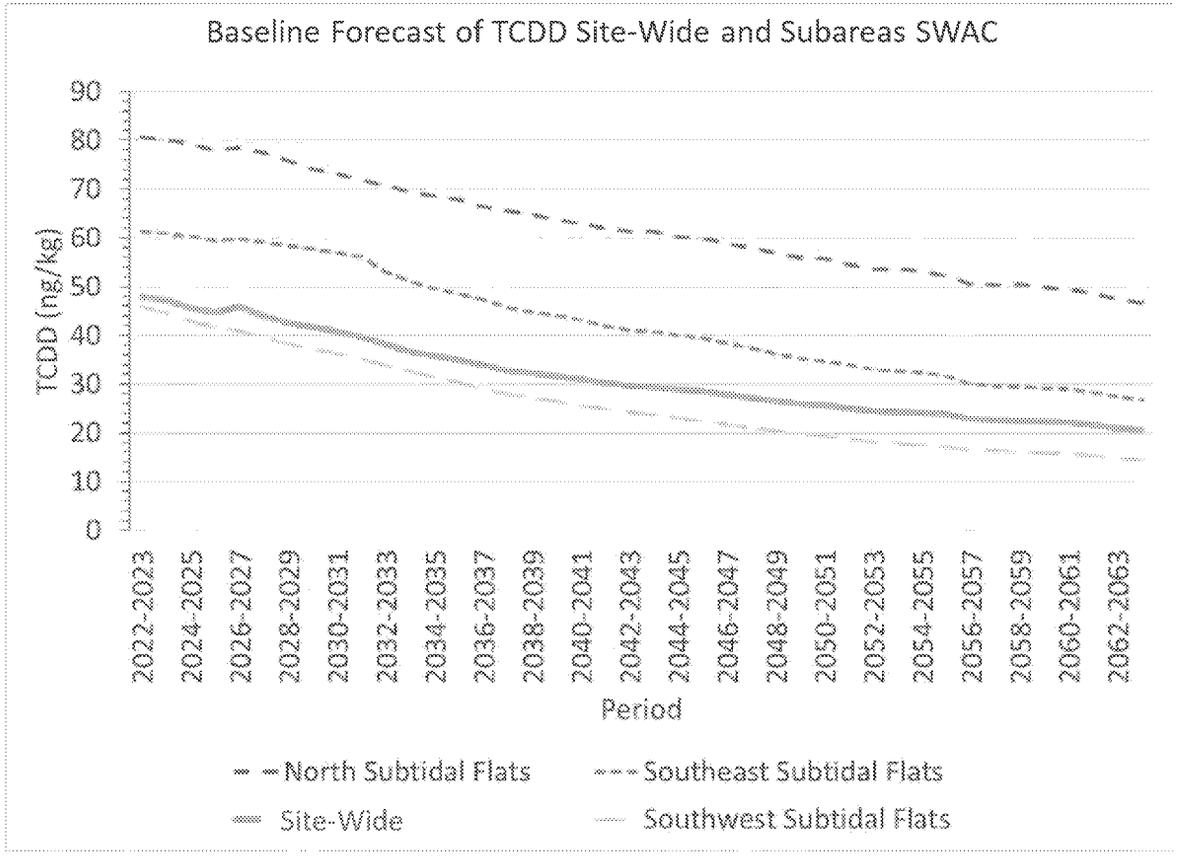


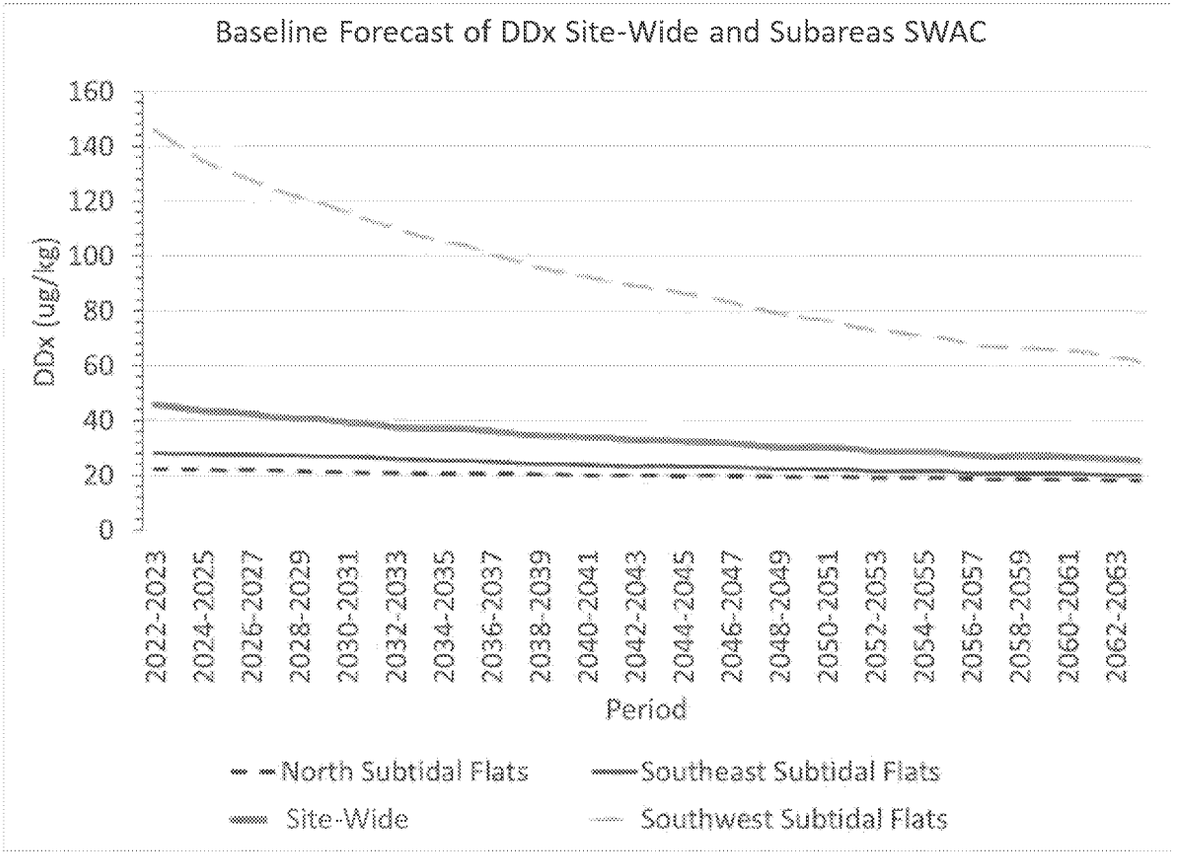
Simulated RAL (BRV: WCS)
Simulated RAL (BRV: BSAC)
Area Exceeding Simulated RAL (BRV: WCS)
Area Exceeding Simulated RAL (BRV: BSAC)

COC	Units	Water Column Solids Concentrations (Mean of NBSA Stations)[1]	Borrow Source Acceptance Criteria[2]
2,3,7,8-TCDD	ng/kg	81.3	4.15
Total DDx (4,4')	µg/kg	68.5	0.150

BSAC: borrow source acceptance criteria
BRV: bed replacement value
WCS: water column solids

2,3,7,8-TCDD and Total DDx (4,4') Baseline Forecasts





Largest opportunity to reduce 2,3,7,8-TCDD SWAC in north subtidal flats

Largest opportunity to reduce total DDx (4,4') SWAC in southwest subtidal flats

Estimating Time-to-Target Improvement

- Timing Considerations:
  - OU2/OU4 remedial actions will reduce sources to Newark Bay.
  - Harbor deepening will alter sediment dynamics to some degree.
  - Ongoing remedial programs in Arthur Kill, Kill Van Kull, and the Hackensack River under other programs may reduce sources in the interim.
- These considerations suggest timing OU3 actions to chronologically follow completion of work in OU2/OU4 may be beneficial.
- Assuming the baseline forecast reasonably predicts bay-wide COC trends, results can be used to estimate the "starting value" needed to achieve a specific time target.
  - Later, scenarios the CFT model can be run to refine time-to-target projections.

Example of Hilltopping with Time-to-Target Consideration: Total DDx (4,4'), NBSA-wide

CFT Projection of Current Condition:

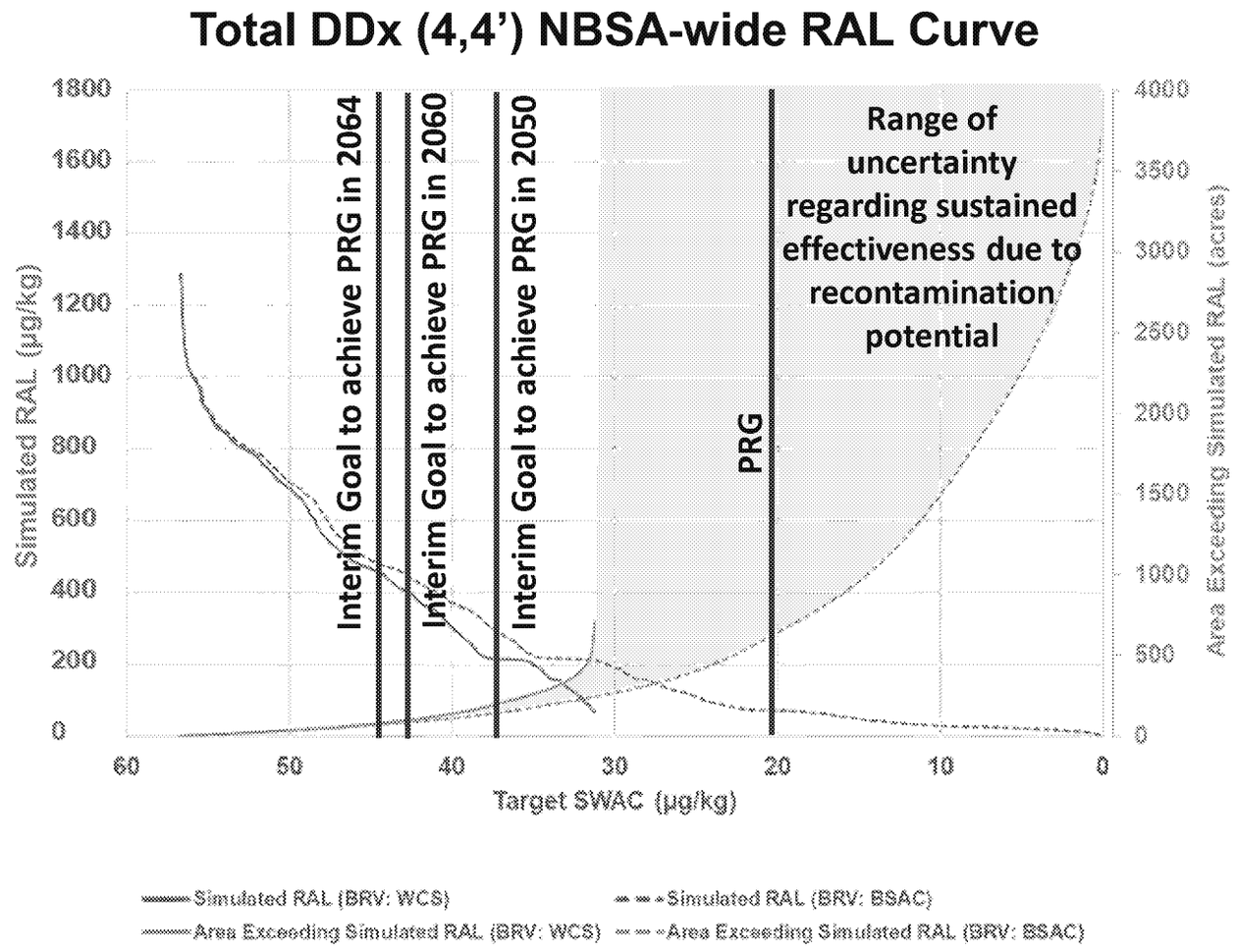
- USEPA ran the CFT model from 2016 to 2022 to project the 2016 Phase III based value to estimate 2022-2023 SWAC for the start of the baseline forecast.

CFT Baseline Forecast Model Result

Year	SWAC (µg/kg)	Ratio to 2035
2016 (Phase III)	56.8	1.54
2022-2023	45.9	1.24
2035-2036	36.9	1
2050-2051	30.2	0.82
2060-2061	26.8	0.73
2063-2064	25.6	0.69

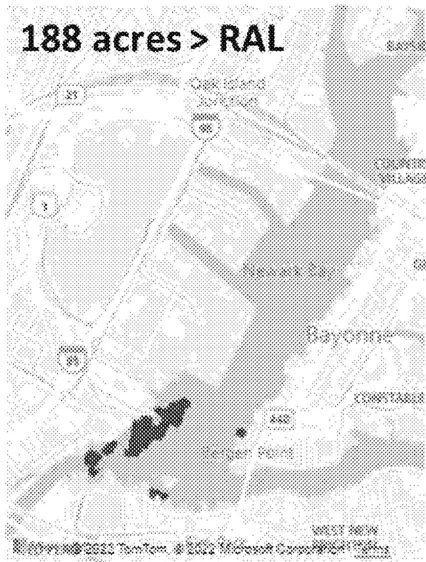
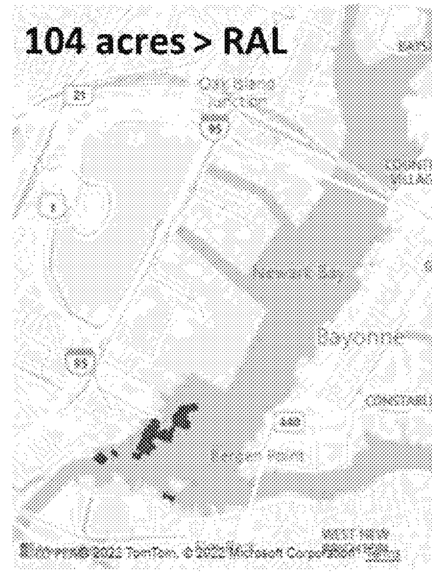
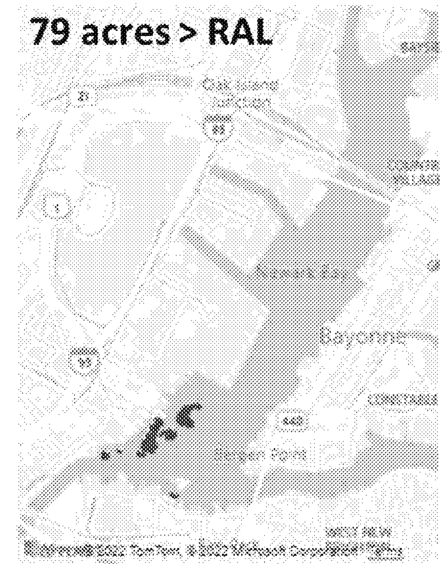
Time-to-Target	Target SWAC (µg/kg)	2035 Interim Goal needed to achieve Time-to-Target	2016 SWAC Needed to Achieve Target	Values estimated from Phase III Data Hilltopping Results			
				RAL (µg/kg)	Area > RAL (acres)	RAL (µg/kg)	Area > RAL (acres)
				Water Column BRV = 68.5 µg/kg		Borrow Source BRV = 0.15 µg/kg	
Achieve OU3 PRG in **2050**	20	24.4	37.6	217	188	306	135
Achieve OU3 PRG in **2060**	20	27.6	42.4	390	104	432	87
Achieve OU3 PRG in **2064**	20	28.9	44.4	459	79	478	69

Example of Hilltopping with Time-to-Target Consideration: Total DDx (4,4'), NBSA-wide



- Approach can support selection of interim goals for implementation year (e.g., 2035) to achieve a risk-based value in a desired time-to-target.
- Monitoring would be required over time to understand progress on time-to-target.
- Amenable to adaptive management (e.g., increase size of remediation area and/or update time-to-target).

Example of Hilltopping with Time-to-Target Consideration: Total DDx (4,4'), NBSA-wide

	Achieve OU3 PRG in 2050	Achieve OU3 PRG in 2060	Achieve OU3 PRG in 2064
BRV: Water Column Solids Concentrations			
BRV: Borrow Source Acceptance Criteria